



**ILLINOIS NATURAL
HISTORY SURVEY**
PRAIRIE RESEARCH INSTITUTE

Freshwater mussels of the Mississippi River tributaries: North, North Central, and Central drainages

Alison P. Stodola, Sarah A. Bales, Diane K. Shasteen

INHS Technical Report 2013 (09)

Prepared for:

Illinois Department of Natural Resources: Office of Resource Conservation
U.S. Fish & Wildlife Service
Illinois Natural History Survey

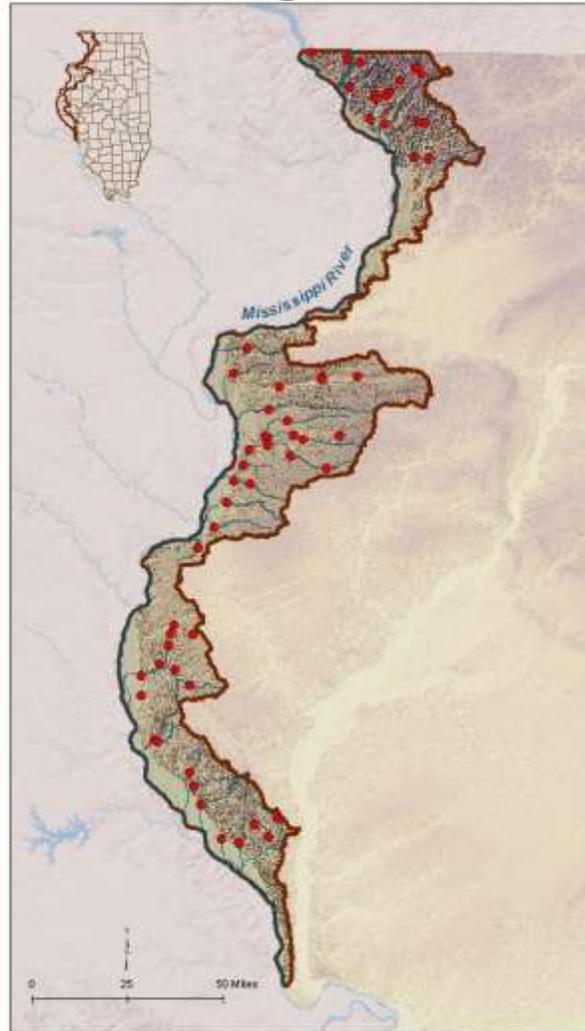
Issued February 22, 2013

Prairie Research Institute, University of Illinois at Urbana Champaign
William Shilts, Executive Director

Illinois Natural History Survey
Brian D. Anderson, Director
1816 South Oak Street
Champaign, IL 61820
217-333-6830



Freshwater mussels of the Mississippi River tributaries: North, North Central and Central drainages



2013

Illinois Natural History Survey, Prairie Research Institute, University of Illinois
Illinois Department of Natural Resources

Alison P. Stodola, Sarah A. Bales, Diane K. Shasteen

Preface

While broad geographic information is available on the distribution and abundance of mussels in Illinois, systematically collected mussel-community data sets required to integrate mussels into aquatic community assessments do not exist. In 2009, a project funded by a US Fish and Wildlife Service State Wildlife Grant was undertaken to survey and assess the freshwater mussel populations at wadeable sites from 33 stream basins in conjunction with the Illinois Department of Natural Resources (IDNR)/Illinois Environmental Protection Agency (IEPA) basin surveys. Inclusion of mussels into these basin surveys contributes to the comprehensive basin monitoring programs that include water and sediment chemistry, instream habitat, macroinvertebrate, and fish, which reflect a broad spectrum of abiotic and biotic stream resources. These mussel surveys will provide reliable and repeatable techniques for assessing the freshwater mussel community in sampled streams. These surveys also provide data for future monitoring of freshwater mussel populations on a local, regional, and watershed basis.

Agency Contacts

Kevin S. Cummings, INHS, ksc@inhs.illinois.edu, (217)333-1623

Bob Szafoni, IDNR, Robert.szafoni@illinois.gov, (217)348-0175

Ann Marie Holtrop, IDNR, ann.holtrop@illinois.gov, (217)785-4325

Suggested Citation

Stodola, A.P., S.A. Bales, and D.K. Shasteen. 2013. Freshwater mussels of the Mississippi River tributaries: North, North Central and Central drainages. Illinois Natural History Survey Technical Report 2013 (09). Champaign, Illinois. 20 pp + appendix.

Acknowledgements

This study was supported by funding from the US Fish and Wildlife Service, State Wildlife Grant (T-53-D-1, Investigating Mussel Communities in Illinois Streams), IDNR, and INHS. Our extreme gratitude goes to the primary investigators for the project: Ann Holtrop, Kevin Cummings, Robert Szafoni, and Dr. Yong Cao, who served as our mentors and made this project possible. We would like to thank all people involved in our surveys, especially our field assistants (Andrew Berger, Brittanie Dabney, Shawn Gibbs, Kacie Jonasen, Cassi Moody, John Pfeiffer, Hunter Ray, Melissa Ruether, Jen Schwab, Matt Walker Corrina Wendel, and Rachel Vinsel), IDNR fisheries biologists, IEPA water monitoring biologists, and volunteers from other agencies. We would like to extend gratitude to all the land owners, both public and private, who allowed us access to their properties. We would like to thank Andrew Hulin for the creation of maps for this report and Christine Mayer for INHS Collection database support.

Introduction

Freshwater mussel populations have been declining for decades and are among the most seriously impacted aquatic animals worldwide (Bogan 1993, Williams et al. 1993). It is estimated that nearly 70% of the approximately 300 North American mussel taxa are extinct, federally-listed as endangered or threatened, or in need of conservation status (Williams et al. 1993, Strayer et al. 2004). In Illinois, 25 of the 62 extant species (44%) are listed as threatened or endangered (Illinois Endangered Species Protection Board 2011) and an additional 5 species are species in greatest need of conservation (SGNC; IDNR 2005a). The Upper Mississippi River tributaries in Illinois are comprised of the direct tributaries to the Mississippi River in western and northwestern Illinois and are broken into three sections for this report. We summarize the mussel surveys conducted in the North, North Central, and Central Mississippi River tributaries from 2009 to 2012 at IEPA/IDNR basin survey sites and previously-ranked disturbance sites.

North Mississippi River Tributaries

The North Mississippi River tributaries are located in the far northwestern corner of Illinois and contain the Galena, Apple, and Plum River drainages and several tributary creeks. This region drains approximately 1376 km² (855 mi²) and covers parts of Carroll, Jo Daviess and Stephenson counties (Page et al. 1992). The North Mississippi tributaries flow through several natural divisions, including the Mississippi River Sand Area, Upper Mississippi River Bottomlands, Rock River Hill Country, and, primarily, the Wisconsin Driftless Area (Schwegman 1973).

Much of the landscape in this drainage is characterized by canyons, v-shaped valleys and varying topography, since most of the area escaped glaciation. Land use in the region is mainly pasture and row-crop agriculture, and urban areas are sparse. The largest urban center is Galena, Illinois, with a population of approximately 3500 people (US Census Bureau 2010). While this area remains rural, Galena has experienced growth in recent decades of vacation homes and weekend getaways (IDNR 1998). In addition to the threat of growing development, silt exists as a primary pollutant from runoff from livestock yards and agricultural lands (Page et al. 1992). Streams are subject to frequent and seasonal flooding due to the high gradient landscape, and some areas exhibit bank erosion and elevated levels of suspended sediments. Stream habitats in the region vary greatly; some streams are dominated by boulder, cobble, and bedrock and others are comprised of soft substrates.

North Central Mississippi River Tributaries

The North Central Mississippi River tributaries are located south of the Rock River drainage and contain the Edwards River, Henderson and Cedar Creek drainages, and several minor tributaries. These streams flow through portions of Hancock, Henderson, Henry, Knox, Mercer,

Rock Island, and Warren counties and drain approximately 2630 km² (1630 mi²) of western Illinois (Page et al. 1992; IDNR 2005b). The North Central tributaries flow through several natural divisions, including the Western Grand Prairie, the Galesburg section of the Western-Forest Prairie, the glaciated section of the Middle Mississippi, the Mississippi River Sand Area, and the Upper Mississippi River Bottomlands (Schwegman 1973).

The primary land use in the North Central Mississippi tributary region is agriculture, both row-crop and pasture. Urban areas are few, and Galesburg is the largest urban area with a population of approximately 32,000 residents (IDNR 2005b; US Census Bureau 2010). Stream habitats consist of firm to shifting sandy runs, cobble and gravel riffles, and occasional claypan banks. Stream banks are often steep and consist of mostly vegetated banks or bedrock outcroppings. Impairments to aquatic habitat are in the form of agriculture run-off (e.g., chemical pollutants, elevated turbidity, etc.) and effluent from wastewater treatment systems from Galesburg, Monmouth, and other smaller municipalities.

Central Mississippi River Tributaries

The Central Mississippi River tributaries are comprised of Bear and Bay Creeks, The Sny, and several minor tributaries to the Mississippi River and are located in the westernmost portion of Illinois. These tributaries encompass portions of Adams, Calhoun, Hancock, and Pike Counties and flow through the Galesburg section of the Western Forest-Prairie, the Mississippi River Bottomlands, and the Glaciated and Driftless sections of the Middle Mississippi Border (Schwegman 1973). The region currently drains approximately 2375 km² (1475 mi²). Most of the stream sections within the Mississippi River floodplain have been dredged, channelized, leveed, or diverted for agricultural drainage. Furthermore, several drainages to the Mississippi River have been permanently modified; the Sny drainage previously contained McCraney, Hadley, Six Mile and Bay Creeks, although these streams now are diverted via ditches to the Mississippi River (Page et al. 1992).

Land use in the Central Mississippi tributary region is mainly row-crop agriculture and pastureland. Forested areas persist along steep banks outside of the Mississippi River floodplain. Urban areas and impacts are sparse in this region, since the largest municipality of Quincy (population ~40,000) lies on the Mississippi River (US Census Bureau 2010). Impairments to aquatic habitats include agricultural runoff, chemical pollution, bank destabilization, silt input (Figure 1), and channelization and alteration of stream drainages. Streams in this region are highly variable and are comprised of sand, gravel, cobble, and occasionally bedrock.

Methods

Freshwater mussel data were collected at 60 sites between June and September of 2009-2012: 18 sites in the North Mississippi tributaries, 23 sites in the North Central Mississippi tributaries, and 18 sites in the Central Mississippi tributaries (Figure 2; Table 1). Locations of sampling sites are listed in Table 1 along with information regarding IDNR/IEPA sampling at the site. In most cases, mussel survey locations were the same as IDNR/IEPA sites.

Live mussels and shells were collected at each sample site to assess past and current freshwater mussel occurrences. Live mussels were surveyed by hand grabbing and visual detection (e.g., trails, siphons, exposed shell) when water conditions permitted. Efforts were made to cover all available habitat types present at a site including riffles, pools, slack water, and areas of differing substrates. A four-hour timed search method was implemented at each site (Table 1). Live mussels were held in the stream until processing.

Following the timed search, all live mussels and shells were identified to species and recorded (Table 2). For each live individual, shell length (mm), gender, and an estimate of the number of growth rings were recorded. Shell material was classified as recent dead (periostracum present, nacre pearly, and soft tissue may be present) or relict (periostracum eroded, nacre faded, shell chalky) based on condition of the best shell found. A species was considered extant at a site if it was represented by live or recently dead shell material (Szafoni 2001). The nomenclature employed in this report follows Turgeon et al. (1998) except for recent taxonomic changes to the gender ending of lilliput (*Toxolasma parvum*), which follows Williams et al. (2008; Appendix 1). Voucher specimens were retained and deposited in the Illinois Natural History Survey Mollusk Collection. All non-vouchered live mussels were returned to the stream reach where they were collected.

Parameters recorded included extant and total species richness, presence of rare or listed species, and individuals collected, expressed as catch-per-unit-effort (CPUE; Table 2). A population indicated recent recruitment if individuals with lengths less than 30 mm or with 3 or fewer growth rings were observed. Finally, mussel resources were classified as Unique, Highly Valued, Moderate, Limited, or Restricted (Table 2) based on the above parameters (Table 3) and following criteria outlined in Table 4 (Szafoni 2001).

Results

Species Richness

A total of 34 species of freshwater mussels were observed in the upper Mississippi tributaries, 27 of which were live (Table 2). Live mussels were collected at 30 of 60 sites, and of the remaining 30 sites, 17 sites had no unionids, 6 sites had only relict shell, and 7 sites had only

dead shell (Figure 3). Across all sites, the number of species collected ranged from 0 to 13 live, 0 to 15 extant (live + dead), and 0 to 17 total species (live + dead + relict). Examined by drainage, the North Mississippi drainage species richness ranged from 0 to 10 live, 0 to 12 extant, and 0 to 13 total species. Species richness for the North Central Mississippi drainage ranged from 0 to 13 live, 0 to 15 extant, and 1 to 17 total species. The Central Mississippi drainage species richness ranged from 0 to 9 live, extant and total species. Across all sites in the upper Mississippi tributaries, the lilliput (*Toxolasma parvum*) and creeper (*Strophitus undulatus*) were the most widespread species, both collected at 14 of 60 sites (23%; Table 2d). In the North Mississippi drainage, the fatmucket (*Lampsilis siliquoidea*) was the most widespread species, collected at 3 of 18 sites (17%; Figure 4a). In the North Central Mississippi drainage, the creeper was the most widespread species, collected at 13 of 23 sites (57%; Figure 4b). Other widespread species were the plain pocketbook (*Lampsilis cardium*; 43%) and mapleleaf (*Quadrula quadrula*; 43%). In the Central Mississippi drainage, the most widespread species was the lilliput, which was collected at 7 of 18 sites (39%; Figure 4c). The pondmussel (*Ligumia subrostrata*) was collected at 5 of 18 sites (28%).

Abundance and Recruitment

A total of 1359 individuals were collected across 60 sites, and the number of live individuals collected at a site ranged from 1 to 162. By drainage, the range of live individuals collected ranged from 10 to 136 in North Mississippi drainage sites, from 1 to 162 at North Central drainage sites, and from 1 to 136 in Central Mississippi drainage sites. A total of 240 collector-hours were spent sampling, with an average of 5.7 mussels collected per hour. The most commonly collected species across all sites was the lilliput, which comprised 22% of all individuals collected (n=296; Table 2d). The giant floater was the most commonly collected species in the North Mississippi drainage (n=91; Table 2a), the plain pocketbook was the most commonly collected species in the North Central Mississippi drainage (n=128; Table 2b), and the lilliput was the most commonly collected species in the Central Mississippi drainage (n=247; Table 2c).

Recruitment for each species was determined by the presence of individuals less than 30 mm or with 3 or fewer growth rings. Smaller (i.e. younger) mussels are harder to locate by hand grab methods and large sample sizes can be needed to accurately assess population reproduction. However, a small sample size can provide evidence of recruitment if it includes individuals that are small or possess few growth rings. Alternatively, a sample consisting of very large (for the species) individuals with numerous growth rings may suggest a senescent population.

Recruitment observed at individual sites ranged from none to high across the basin; over half of sites where live mussels were collected (n=30 sites) had no observed recruitment (16 of 30 sites; Figure 5). We observed recruitment in over 50% of species collected at three sites,

Edwards River (site 24) and two sites on Bear Creek (sites 44 and 49). Several sites had observed recruitment of 30-50% of species collected: sites 21, 25, and 30 in the North Central Mississippi drainage (Edwards River, Pope and North Henderson Creeks), and sites 45, 46, and 48 in the Central Mississippi drainage (Bear Creek and South Fork Bear Creek).

Mussel Community Classification

Based on the data collected in the 2009-2012 basin survey, 60% of the sites where mussels were collected (18 of 30 sites with mussels) in the upper Mississippi River tributaries are classified as Moderate or Highly Valued mussel resources under the current MCI classification system (Table 4, Figure 5). Two sites in the North Mississippi drainage, South Fork Apple River (site 6) and Apple River (site 13), were classified as Highly Valued mussel resources. Three sites in the North Central drainage, including Camp Creek (site 22), Edwards River (site 24) and Cedar Creek (site 34), were also Highly Valued mussel resources. In the Central Mississippi drainage, four sites on Bear Creek (sites 42, 44, 45, and 49) were classified as Highly Valued mussel resources (Figure 5).

Noteworthy Finds

This survey collected 27 live species and 34 total species; 37 species were known historically from the upper Mississippi River tributaries. Two species, elktoe (*Alasmidonta marginata*) and pyramid pigtoe (*Pleurobema rubrum*), were found as relict shells during our survey and had not been documented from these drainages previously. Five species with historical records from this drainage that were not collected during this survey were the mucket (*Actinonaias ligamentina*), rock pocketbook (*Arcidens confragosus*), purple wartyback (*Cyclonaias tuberculata*), washboard (*Megalonaias nervosa*), and hickorynut (*Obovaria olivaria*).

Six species, elktoe (*Alasmidonta marginata*), spike (*Elliptio dilatata*; state-threatened), ebonyshell (*Fusconaia ebena*; state-threatened), flutedshell (*Lasmigona costata*; SGNC), pyramid pigtoe (*Pleurobema rubrum*; state-endangered), and round pigtoe (*Pleurobema sintoxia*) were only represented in our surveys by relict shell. Our survey also found relatively few or no live occurrences for the flat floater (*Anodonta suborbiculata*), slippershell mussel (*Alasmidonta viridis*; state-threatened), wartyback (*Quadrula nodulata*), paper pondshell (*Utterbackia imbecillis*), and ellipse (*Venustaconcha ellipsiformis*; SGNC), although dead and relict shell records were found at one or more sites.

Two state-listed species, slippershell and black sandshell (*Ligumia recta*), were found alive in our survey (Table 2a). The slippershell was recorded alive at one site (site 6; South Fork Apple River) and was represented by three individuals. The black sandshell was recorded alive at two sites, 13 and 34, which are Apple River and Cedar Creek, respectively (Table 2a and 2b).

Discussion

Noteworthy species

Two state-threatened species were collected alive in our survey, the slippershell mussel and black sandshell. Three live slippershell mussels, a rarity in the North Mississippi tributaries, were collected at one location in the South Fork Apple River (site 6) and one relict shell was collected in the Galena River (site 2). The North Mississippi tributaries are on the periphery of the range for the slippershell mussel, and it is not expected to occur in any of the Central Mississippi tributaries (Cummings and Mayer 1992). The black sandshell was collected at one site in the North tributaries (Apple River at Hanover; site 13) and one site in the North Central tributaries (Cedar Creek; site 34). Sietman et al. (2002) collected live black sandshells at four sites in the lower Apple River (at or downstream of Hanover); this species appears to persist in the lower Apple River and Cedar Creek, but remains rare or absent elsewhere in the upper Mississippi tributaries. The areas containing these state-threatened species are unique and these populations should be protected. Of additional note is that our surveys documented elktoe and pyramid pigtoe for the first time in these Mississippi tributaries. Although they are new (relict) records, the pyramid pigtoe is considered extirpated in Illinois and the elktoe, if present alive, is likely a small portion of the mussel fauna.

Community Comparisons and Historical Species

Species assemblages varied among the three drainages. While the Mississippi tributaries share the commonality of the Mississippi River, the three drainages covered in this report vary latitudinally thus we expected differences in mussel assemblage. For example, the range of the pondmussel (*Ligumia subrostrata*) is generally restricted to central and southern Illinois (Cummings and Mayer 1992), and our survey coincidentally only collected them in the Central Mississippi tributaries. Similarly, the range of the ellipse is restricted to northern and central Illinois, and we only collected them in the North and North Central Mississippi tributaries. Several species that are common across all of Illinois were collected in all three drainages. These are: fragile papershell (*Leptodea fragilis*), giant floater, lilliput, mapleleaf, pink heelsplitter (*Potamilus alatus*), threeridge (*Amblema plicata*), and white heelsplitter (*Lasmigona complanata*).

Thirty-seven species have been documented from the North, North Central, and Central Mississippi tributaries, but very few studies have been published regarding the freshwater mussel fauna of these streams. Thus, it is difficult to determine the intactness and/or historical fauna of these drainages. The only published study available (Sietman et al. 2002) covers the lower Apple River, which was extensively sampled by INHS in the 2000s. Much of the sampling area cited was not sampled in our surveys due to non-wadeable water depths in the lower

Apple River. A few historical records for the remainder of the region do exist in the INHS Mollusk Collection database, yet most collection sites do not coincide with IDNR/IEPA basin survey sites (i.e., NDA for Historical Records in Table 2). Nevertheless, we can partially infer the historical species richness from shell records and current shell condition. Based on our survey and past surveys (INHS Mollusk Collection; Sietman 2002), we have identified several species that are likely extirpated from the Upper Mississippi tributaries: ebonyshell, elktoe, mucket, purple wartyback, pyramid pigtoe, round pigtoe, and spike. These species have not been collected as live or dead in several decades and, if collected, were only represented by relict shell in our surveys (INHS Collections database; Table 2). The elktoe, round pigtoe, and mucket are common in other areas in Illinois, and reasons for their decline here are unknown. The other species are rare (or extirpated) throughout their range in Illinois and are federally or state-endangered.

Summary

On the whole, tributaries for the Mississippi River in Illinois do not contain exceptionally diverse or abundant freshwater mussel resources. Half of the sites sampled (i.e., 30 of 60 sites) in our survey did not have live unionids, and 17 sites had no shell material present (Table 2; Figure 3). Many of the sites of the North and Central Mississippi basins had drainage areas of less than 100 km² and the topography in these regions is dominated by canyons, v-shaped valleys and rocky substrates due to lack of glaciation present in the Driftless area. However, within the drainages, a few sites stand out as noteworthy based on presence of listed or intolerant species, reproduction, richness, or individuals collected. In the North Mississippi tributaries, South Fork Apple River and Apple River (sites 6 and 13, respectively) were Highly Valued mussel resources. These sites both contained live individuals of state-listed species. The most mussel-rich drainage was the North Central Mississippi tributaries; Camp Creek, Edwards River, and Cedar Creek (sites 22, 24, and 34) were classified as Highly Valued Mussel Resources. These sites each had at least 10 extant species, more than 50 total individuals collected, and/or listed or intolerant species present (Camp Creek, site 34). The sites within this region extend into the forest-prairie division and tend to have larger drainages (200 to 800 km²) than other streams sampled in these basins. In the Central Mississippi tributaries, mussels were only collected in the Bear Creek drainage. Four sites on Bear Creek, which has the largest drainage in the basin, were Highly Valued mussel resources (sites 42, 44, 45, and 49). These sites had many individuals collected (90 – 136), at least 5 extant species, and high rates of reproduction. The most widespread species, as well as the most-collected species in these drainages (e.g., lilliput, creeper, fatmucket, plain pocketbook, giant floater; Table 2 and Figure 4), are among the most common and widespread species in Illinois (Cummings and Mayer 1997; Tiemann et al. 2007). However, populations of diverse, reproducing mussels persist in several areas in these drainages and should be recognized for future preservation.

Literature Cited

Bogan, A.E. 1993. Freshwater bivalve extinctions (Mollusca: Unionoida): a search for causes. *American Zoologist* 33(6):599-609.

Cummings, K.S., and C. A. Mayer. 1992. *Field Guide to Freshwater Mussels of the Midwest*. Illinois Natural History Survey, Champaign.

Cummings, K.S., and C.A. Mayer. 1997. Distributional checklist and status of Illinois freshwater mussels (Mollusca: Unionacea). Pages 129-145 in: K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo (eds.) *Conservation and management of freshwater mussels II: initiatives for the future*. Proceedings of a UMRCC Symposium, October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Illinois Department of Natural Resources. 1998. *Driftless Area Assessment*. Published by the State of Illinois.

Illinois Department of Natural Resources. 2005a. *The Illinois Comprehensive Wildlife Conservation Plan and Strategy, Version 1.0*. Illinois Department of Natural Resources, Springfield, Illinois.

Illinois Department of Natural Resources. 2005b. *The Mississippi Western Five: an inventory of the region's resources*. Published by the State of Illinois.

Illinois Endangered Species Protection Board. 2011. *Checklist of Endangered and Threatened Animals and Plants of Illinois*. Illinois Endangered Species Protection Board, Springfield, Illinois. 18 pp.

Page, L.M., K.S. Cummings, C.A. Mayer, S.L. Post, and M.E. Retzer. 1992. *Biologically significant Illinois streams, an evaluation of the streams of Illinois based on aquatic biodiversity*. Illinois Natural History Survey, Center for Biodiversity, Technical Report. 1992(1):vi + 485 pp.

Schwegman, J.E. 1973. *Comprehensive plan for the Illinois nature preserves system. Part 2. The natural divisions of Illinois*. Illinois Nature Preserves Commission, Springfield, Illinois.

Sietman, B.E., E.A. Anderson, R. Nyboer, and F.R. Hutto. 2002. *The unionid mussel fauna of Lost Mound National Wildlife Refuge (Savanna Army Depot), Upper Mississippi River and lower Apple River*. Illinois Natural History Survey Technical Report 2002(29)iii-32 + 1 appendix.

Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton, and S.J. Nichols. 2004. Changing perspective on pearlymussels, North America's most imperiled animals. *BioScience* 54(5):429-439.

Szafoni, R. E. 2001. Protocol for integrating freshwater mussel surveys into IDNR / IEPA stream basin surveys. Version 2.0. IDNR/ORC/Natural Heritage, Charleston, IL. 5pp.

Tiemann, J.S., K.S. Cummings, C.A. Mayer. 2007. Updates to the distributional checklist and status of Illinois freshwater mussels (Mollusca: Unionacea). Transactions of the Illinois State Academy of Science 100 (1):107-123.

Turgeon, D.D., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, J.F. Quinn, Jr., C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, M.J. Sweeney, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society, Special Publication 26:ix-526.

U.S. Census Bureau; 2010 Census National Summary File of Redistricting Data; generated by Alison Price; using American FactFinder; <<http://factfinder.census.gov>>; (10 December 2012)

Williams, J.D., A.E. Bogan, and J.T. Garner. 2008. Freshwater mussels of Alabama and the Mobile Basin of Georgia, Mississippi, and Tennessee. University of Alabama Press, Tuscaloosa, Alabama. xv + 908 p.

Williams, J.D., M.L. Warren, Jr., K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18(9):6-22.

Table 1. 2009-2012 Survey sites for the Mississippi River tributaries. Types of samples MU-mussel sampling, W-water chemistry, CM- Continuous Monitoring, F-fish sampling, FF-fish flesh, M-macroinvertebrate, and H-habitat. *estimated.

Site Number	IEPA Code	Stream	Types of Samples	County	Location	Watershed area (km ²)
North Mississippi Tributaries						
1	MU-01	Menominee River	MU, W, M, H, F	Jo Daviess	3.7 mi E Dubuque, Iowa, at Tranel Road bridge	56.1
2	MQ-02	Galena River	MU, W, M, H, F	Jo Daviess	5.75 mi E Menominee, Council Hill Rd. bridge	387.4
3	MQB-01	East Fork Galena River	MU, W, M, H, F	Jo Daviess	4.4 mi W Scales Mound, North Ford Rd. bridge	5.9
4	MPA-01	Smallpox Creek	MU, W, M, H, F	Jo Daviess	3.7 mi SSE Galena, South Rocky Hill Rd. bridge	70.5
5	MN-07	Apple River	MU, W, M, H, F	Jo Daviess	7.3 mi N Stockton, Apple River Canyon State Park	103.3
6	MNI-12	South Fork Apple River	MU, W, M, H, F	Jo Daviess	5 mi N Stockton, Koppersmith Rd. bridge	87.7
7	MNIA-11	Clear Creek	MU, W, M, H, F	Jo Daviess	4.3 mi SW Warren, Apple River Canyon State Park	33.6
8	MN-04	Apple River	MU, W, M, H, F	Jo Daviess	6.8 mi NW Stockton, Townsend Rd. bridge	294.1
9	MN-13	Apple River	MU	Jo Daviess	2.3 mi NW Woodbine, near S Grebner Rd.	453.8
10	MN-05	Apple River	MU, W, M, H, F	Jo Daviess	1.4 mi NE Elizabeth, Goosehollow Rd. bridge	458.9
11	MNDA-01	Long Hollow	MU, W, M, H, F	Jo Daviess	2.9 mi NW Elizabeth, off Long Hollow Rd.	20.3
12	MND-01	Furnace Creek	MU	Jo Daviess	2 mi NW Elizabeth, Long Hollow Rd. bridge	46.4
13	MN-01	Apple River	MU	Jo Daviess	at Hanover, off Fulton Rd. bridge	629.9
14	ML-01	Rush Creek	MU	Jo Daviess	4 mi ESE Hanover, Gamble Hill Rd. bridge	140.0
15	MJ-02	Plum River	MU, W, M, H, F	Jo Daviess	7.5 mi SSW Stockton, East Knapp Rd. bridge	75.2
16	MJE-01	Muddy Plum River	MU, W, M, H, F	Jo Daviess	7.5 mi S Stockton, S. Brunner Rd. bridge	35.9
17	MJB-03	Carroll Creek	MU, W, M, H, F	Carroll	Mount Carroll, Galena St. bridge	132.1
18	MJB-02	Carroll Creek	MU	Carroll	5.3 mi E Savanna, Scenic Palisades Rd. bridge	164.9
North Central Mississippi Tributaries						
19	MZA-03	Copperas Creek	MU, W, M, H	Rock Island	2 mi S Illinois City, 238th St. W bridge	120.6
20	MWD-01	Eliza Creek	MU, W, F, M, H	Mercer	1 mi S Eliza, 675 E bridge	77.2
21	LF-08	Edwards River	MU	Henry	2.3 mi SW Andover, 500E bridge	385.5
22	LFD-01	Camp Creek	MU	Mercer	3 mi S Sherrard, 140th street	164.8
23	LF-07	Edwards River	MU	Mercer	2 mi S Cable, 297th street	710.8
24	LF-10	Edwards River	MU	Mercer	2 mi NNE Aledo, Rt 94 bridge	845.7
25	LE-03	Pope Creek	MU, W, F	Mercer	4 mi W Aledo, 1600E bridge	355.3
26	LD-22	Henderson Creek	MU	Knox	5 mi NW Galesburg, Moshier Hill Road bridge	88.0
27	LD-07	Henderson Creek	MU, W, F, M, H	Warren	3.5 mi SW Alexis, 900E bridge	254.5
28	LD-06	Henderson Creek	MU	Warren	2.0 mi N Little York, 285th street bridge	265.6
29	LD-05	Henderson Creek	MU	Warren	1.5 mi NW Little York, 1st street bridge	436.3
30	LDE-03	North Henderson Creek	MU, W, F, M, H	Mercer	5 mi E Seaton, 2100E bridge	115.8
31	LDE-01	North Henderson Creek	MU	Henderson	4 mi S Seaton, 2800N bridge	223.4
32	LDD-24	Cedar Creek	MU, W, F, M, H	Warren	6 mi WSW Galesburg, 1550E bridge	93.8
33	LDD-14	Cedar Creek	W, F, M, H, FF	Warren	3 mi NW Monmouth, 600E bridge	269.8
34	LDD-11	Cedar Creek	MU	Henderson	2 mi W Little York, 1st street bridge	429.4
35	LD-08	Henderson Creek	MU, W, F	Henderson	2.5 mi E Big River State Forest, off 2450N	1160.2
36	LDB-01	Smith Creek	MU, W, F, M, H	Henderson	2 mi E Oquakwa, 1470E ford	47.7
37	LDA-03	South Henderson Creek	MU	Henderson	Country Club NW edge Biggsville	212.9
38	LDA-01	South Henderson Creek	MU, W, F, M, H	Henderson	NE edge Gladstone, Liberty Rd. bridge	243.1
39	LC-01	Ellison Creek	MU, W, F, M, H	Henderson	5 mi NW Stronghurst, 1050E bridge	253.0
40	LZF-01	Honey Creek	MU, W	Henderson	1.5 mi NE Lomax, 800E bridge	145.1
41	LB-02	Camp Creek	MU, W, F, M, H	Hancock	3 mi SE Dallas City, 2820N bridge	80.9
Central Mississippi Tributaries						
42	KI-06	Bear Creek	MU	Hancock	2.3 mi WSW Basco, 800N bridge	212.0
43	KIU-01	Slater Creek	MU	Hancock	2.7 mi NE West Point, 1900E bridge	53.4
44	KI-09	Bear Creek	MU, W, CM, F, M, H	Hancock	4.1 mi SW Basco, 600N bridge	150.0*
45	KI-05	Bear Creek	MU	Hancock	4.6 mi SW West Point, 250N bridge	335.9
46	KIF-04	South Fork Bear Creek	MU	Adams	4 mi N Coatsburg, 1850E bridge	118.0
47	KIF-05	South Fork Bear Creek	MU, W, CM, F, M, H	Adams	0.8 mi SW Loraine, 2603N bridge	351.9
48	KI-08	Bear Creek	MU, W, CM, F, M, H	Adams	4.6 mi W Loraine, 1050E bridge	854.1
49	KI-10	Bear Creek	MU	Adams	1 mi W Marcelline, 603rd Rd. bridge	1000.0*
50	KGA-01	Rock Creek	MU	Adams	2 mi SW Ursa, 1950N	118.0
51	KD-01	Mill Creek	MU, W, CM, F, M, H	Adams	6 mi SE Quincy, Hwy 96 bridge	112.6
52	KDA-01	Burton Creek	MU, W, CM, F, M, H	Adams	4.5 km NW Payson, Hwy 96	129.2
53	KCI-02	McCraney Creek	MU, W, CM, F, M, H	Pike	4.5 mi NE Hull, at 1850E bridge	112.1
54	KCH-01	Hadley Creek	MU, W, CM, F, M, H	Pike	1 mi E of Kinderhook, at 1275E bridge	180.6
55	KX-02	Kiser Creek	MU, W, CM, F, M, H	Pike	New Canton, Hwy 96 bridge	156.7
56	KC-03	The Sny	MU, W, CM, F	Pike	2.6 mi SSE Rockport, Hwy 54 bridge	150.0
57	KCB-05	Six Mile Creek	MU, W, CM, F, M, H	Pike	6 mi S New Hartford, at 2500E bridge	65.2
58	KCA-03	Bay Creek	MU, W, CM, F, M, H	Pike	3.6 mi WNW Milton, 3450E bridge	136.1
59	KCAG-03	Honey Creek	MU	Pike	3 mi SW Pittsfield, 2625E bridge	10.5
60	KCAG-04	Honey Creek	MU	Pike	5.5 NNE of Nebo, at 775N ford	76.4

Table 2. Mussel data for sites sampled during 2009-2012 surveys (Table 1) in the North Mississippi tributaries (a), North Central Mississippi tributaries (b), Central Mississippi tributaries (c) and a summary of all sites (d). Numbers in columns are live individuals collected, “D” and “R” indicates that only dead or relict shells were collected. Shaded boxes indicate historic collections at the specific site location obtained from the INHS Mollusk Collection records. Extant species is live+dead shell and total species is live+dead+relict shell. Proportion of total is number of individuals of a species divided by total number of individuals at all sites. MCI scores and Resource Classification are based on values in Tables 3 and 4 (R=Restricted, L=Limited, M=Moderate, HV=Highly Valued, and U=Unique). NDA = no data available.

a. North Mississippi Tributaries (sites 1-18)

Species	North Mississippi Tributaries										Proportion of total
	2	4	5	6	7	9	10	13	14	17	
Subfamily Anodontinae											
<i>Alasmidonta marginata</i>	R										-
<i>Alasmidonta viridis</i>	R			3							1.1%
<i>Anodontoides ferussacianus</i>				38					R		14.4%
<i>Lasmigona complanata</i>									9		3.4%
<i>Lasmigona compressa</i>				5			R				1.9%
<i>Lasmigona costata</i>	R										-
<i>Pyganodon grandis</i>	R	1		90	R			D		R	34.6%
<i>Strophitus undulatus</i>	R						D	7			2.7%
<i>Utterbackia imbecillis</i>								D			-
Subfamily Ambleminae											
<i>Amblema plicata</i>							1	2			1.1%
<i>Elliptio dilatata</i>	R						R				-
<i>Fusconaia flava</i>	R						1	1			0.8%
<i>Pleurobema sintoxia</i>							R				-
<i>Quadrula quadrula</i>								2			0.8%
<i>Tritogonia verrucosa</i>								25			9.5%
Subfamily Lampsilinae											
<i>Lampsilis cardium</i>	R			R			6	43			18.6%
<i>Lampsilis siliquoidea</i>	R			R		R	1	3	4	R	3.0%
<i>Leptodea fragilis</i>	R							2			0.8%
<i>Ligumia recta</i>								4			1.5%
<i>Potamilus alatus</i>								1			0.4%
<i>Toxolasma parvum</i>		11						R	2		4.9%
<i>Truncilla truncata</i>											-
<i>Venustaconcha ellipsiformis</i>	R			R			1				0.4%
Individuals collected	0	12	0	136	0	0	10	90	15	0	263
Live species collected	0	2	0	4	0	0	5	10	3	0	17
Extant species	0	2	0	4	0	0	6	12	3	0	18
Total species collected	11	2	0	7	1	1	9	13	4	2	22
Historical species richness	1	NDA	1	8	NDA	3	11	14	NDA	NDA	
Catch per unit effort (CPUE)	0	3	0	34	0	0	2.5	22.5	3.75	0	
Mussel Community Index (MCI)	0	6	0	13	0	0	9	12	6	0	
Resource Classification	R	L	R	HV	R	R	M	HV	L	R	

b. North Central Mississippi Tributaries (sites 19-41)

Species	North Central Mississippi Tributaries																						Proportion of total	
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40		41
Subfamily Anodontinae																								
<i>Anodontoides ferussacianus</i>							D																	-
<i>Lasmigona complanata</i>	D			30		D	4			2	1	D			54	30	D				R		20.2%	
<i>Pyganodon grandis</i>						D	D		D	D	D	1			R	2				1			0.7%	
<i>Strophitus undulatus</i>			D	24	1	1	2	3	1	D	3	9	R	D	2	9			2	1	1		9.8%	
Subfamily Ambleminae																								
<i>Amblema plicata</i>	R		R		D		R		R	1	1					7	D			R	6		2.5%	
<i>Elliptio dilatata</i>							R									R							-	
<i>Fusconaia flava</i>				6		28	1			R						R							5.8%	
<i>Quadrula nodulata</i>																D	1						0.2%	
<i>Quadrula pustulosa</i>		R	R	24		25										2							8.5%	
<i>Quadrula quadrula</i>			1	33	R	9	4		2	12		1			1	5					6		12.4%	
<i>Tritogonia verrucosa</i>						13				2					4	17	1						6.2%	
<i>Unio merus tetralasmus</i>																			1			R	R	0.2%
Subfamily Lampsilinae																								
<i>Lampsilis cardium</i>				1		D	D		5	12	5		1		17	77	2		D	3	5	D	21.4%	
<i>Lampsilis siliquioidea</i>		D					R								R			R	R				-	
<i>Lampsilis teres</i>					R	1																	0.2%	
<i>Leptodea fragilis</i>				4			D		D	D	3		D	D	D	D	4						1.8%	
<i>Ligumia recta</i>																5				D			0.8%	
<i>Obliquaria reflexa</i>																	R						-	
<i>Potamilus alatus</i>										1	4				1	4				R			1.7%	
<i>Potamilus ohioensis</i>				1					D		3					2					1		1.2%	
<i>Toxolasma parvum</i>		D	1	20	D		1					12										2	6.0%	
<i>Truncilla donaciformis</i>																1							0.2%	
<i>Truncilla truncata</i>						1										1							0.3%	
<i>Venustaconcha ellipsiformis</i>																					R		-	
Individuals collected	0	0	2	143	1	78	12	3	8	30	20	23	1	0	79	162	8	0	3	5	21	0	0	599
Live species collected	0	0	2	9	1	7	5	1	3	6	7	4	1	0	6	13	4	0	2	3	6	0	0	19
Extant species	1	2	3	9	3	10	9	1	6	9	8	5	2	2	7	15	6	0	3	4	6	1	0	21
Total species collected	2	3	5	9	5	10	12	1	7	10	8	5	3	2	9	17	7	1	4	6	8	2	1	24
Historical species richness	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	1	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	
Catch per unit effort (CPUE)	0	0	0.5	35.8	0.25	19.8	3	0.75	2	4.75	5	5.75	0.25	0	19.8	41.3	2	0	0.75	1.25	5.25	0	0	
Mussel Community Index (MCI)	0	0	7	12	4	14	11	4	7	8	10	10	4	0	9	15	7	0	4	9	7	0	0	
Resource Classification	R	R	L	HV	R	HV	M	R	L	M	M	M	R	R	M	HV	L	R	R	M	L	R	R	

c. Central Mississippi Tributaries (sites 42-60)

Species	Central Mississippi Tributaries											Proportion of total
	42	43	44	45	46	47	48	49	51	56	58	
Subfamily Anodontinae												
<i>Anodonta suborbiculata</i>										D		-
<i>Lasmigona complanata</i>	4		18	8		D	D					6.0%
<i>Pyganodon grandis</i>	4		1	D					D	D	R	1.0%
<i>Utterbackia imbecillis</i>			D	1								0.2%
Subfamily Ambleminae												
<i>Amblema plicata</i>								21		R		4.2%
<i>Fusconaia ebena</i>										R		-
<i>Pleurobema rubrum</i>										R		-
<i>Quadrula pustulosa</i>										R		-
<i>Quadrula quadrula</i>						1		11		R		2.4%
<i>Unio merus tetralasmus</i>	7		D	1								1.6%
Subfamily Lampsilinae												
<i>Lampsilis teres</i>				5			D	10			D	3.0%
<i>Leptodea fragilis</i>	R			D			D	1				0.2%
<i>Ligumia subrostrata</i>	61		27	40	3	D	1					26.6%
<i>Obliquaria reflexa</i>								4				0.8%
<i>Potamilus alatus</i>								1				0.2%
<i>Potamilus ohioensis</i>								3				0.6%
<i>Toxolasma parvum</i>	60	4	44	81	16		4	38				49.7%
<i>Truncilla donaciformis</i>								17				3.4%
Summary Statistics												
Individuals collected	136	4	90	136	19	1	5	106	0	0	0	497
Live species collected	5	1	4	6	2	1	2	9	0	0	0	14
Extant species	5	1	6	8	2	3	5	9	1	2	1	15
Total species collected	6	1	6	8	2	3	5	9	1	7	2	18
Historical species richness	NDA	NDA	NDA	2	NDA	NDA	NDA	1	NDA	NDA	NDA	
Catch per unit effort (CPUE)	34	1.33	22.5	34	4.75	0.25	1.25	26.5	0	0	0	
Mussel Community Index (MCI)	12	6	12	13	9	4	10	13	0	0	0	
Resource Classification	HV	L	HV	HV	M	R	M	HV	R	R	R	

d. All upper Mississippi Tributary sites (60 total sites) sampled from 2009-2012. **Actinonaias ligamentina*, *Arcidens confragosus*, *Cyclonaias tuberculata*, *Megalonaias nervosa*, and *Obovaria olivaria* are included in the historical table but are not represented in the table.

	Total individuals	No. sites live	No. sites extant	No. sites relict	Proportion of total live
Subfamily Anodontinae					
<i>Alasmidonta marginata</i>	0	0	0	1	-
<i>Alasmidonta viridis</i>	3	1	1	2	0.2%
<i>Anodonta suborbiculata</i>	0	0	1	1	-
<i>Anodontoides ferussacianus</i>	38	1	2	3	2.8%
<i>Lasmigona complanata</i>	160	10	16	17	11.8%
<i>Lasmigona compressa</i>	5	1	1	2	0.4%
<i>Lasmigona costata</i>	0	0	0	1	-
<i>Pyganodon grandis</i>	100	7	16	20	7.4%
<i>Strophitus undulatus</i>	66	14	18	20	4.9%
<i>Utterbackia imbecillis</i>	1	1	3	3	0.1%
Subfamily Ambleminae					
<i>Amblema plicata</i>	39	7	9	15	2.9%
<i>Elliptio dilatata</i>	0	0	0	4	-
<i>Fusconaia ebena</i>	0	0	0	1	-
<i>Fusconaia flava</i>	37	5	5	8	2.7%
<i>Pleurobema rubrum</i>	0	0	0	1	-
<i>Pleurobema sintoxia</i>	0	0	0	1	-
<i>Quadrula nodulata</i>	1	1	2	2	0.1%
<i>Quadrula pustulosa</i>	51	3	3	6	3.8%
<i>Quadrula quadrula</i>	88	13	13	15	6.5%
<i>Tritogonia verrucosa</i>	62	6	6	6	4.6%
<i>Uniomerus tetralasmus</i>	9	3	4	6	0.7%
Subfamily Lampsilinae					
<i>Lampsilis cardium</i>	177	12	16	18	13.0%
<i>Lampsilis siliquoidea</i>	8	3	4	11	0.6%
<i>Lampsilis teres</i>	16	3	5	6	1.2%
<i>Leptodea fragilis</i>	14	5	14	16	1.0%
<i>Ligumia recta</i>	9	2	3	3	0.7%
<i>Ligumia subrostrata</i>	132	5	6	6	9.7%
<i>Obliquaria reflexa</i>	4	1	1	2	0.3%
<i>Potamilus alatus</i>	12	6	6	7	0.9%
<i>Potamilus ohioensis</i>	10	5	6	6	0.7%
<i>Toxolasma parvum</i>	296	14	16	17	21.8%
<i>Truncilla donaciformis</i>	18	2	2	2	1.3%
<i>Truncilla truncata</i>	2	2	2	2	0.1%
<i>Venustaconcha ellipsiformis</i>	1	1	1	4	0.1%
					Totals
				Individuals collected	1359
				Live species collected	27
				Extant species collected	28
				Total species collected	34
				Historical species	37*

Table 3. Mussel Community Index (MCI) parameters and scores.

Extant species in sample	Species Richness	Catch per Unit Effort (CPUE)	Abundance (AB) Factor
0	1	0-0.99	0
1-3	2	1-10	2
4-6	3	>10-30	3
7-9	4	>30-60	4
10+	5	>60	5
% live species with recent recruitment	Reproduction Factor	# of Intolerant species	Intolerant species Factor
0	1	0	1
1-30	3	1	3
>30-50	4	2+	5
>50	5		

Table 4. Freshwater mussel resource categories based on species richness, abundance, and population structure. MCI = Mussel Community Index Score

Unique Resource MCI \geq 16	Very high species richness (10 + species) &/or abundance (CPUE > 80); intolerant species typically present; recruitment noted for most species
Highly Valued Resource MCI = 12- 15	High species richness (7-9 species) &/or abundance (CPUE 51-80); intolerant species likely present; recruitment noted for several species
Moderate Resource MCI = 8 - 11	Moderate species richness (4-6 species) &/or abundance (CPUE 11-50) typical for stream of given location and order; intolerant species likely not present; recruitment noted for a few species
Limited Resource MCI = 5 - 7	Low species richness (1-3 species) &/or abundance (CPUE 1-10); lack of intolerant species; no evidence of recent recruitment (all individuals old or large for the species)
Restricted Resource MCI = 0 - 4	No live mussels present; only weathered dead, sub-fossil, or no shell material found.



Figure 1. Impairments to aquatic habitats, including suspended sediments (top; site 51) and destabilized banks (bottom; site 58).



Figure 2. Sites sampled in the Mississippi River basin: North, North Central, Central drainages in 2009 - 2012. Site codes referenced in Table 1.

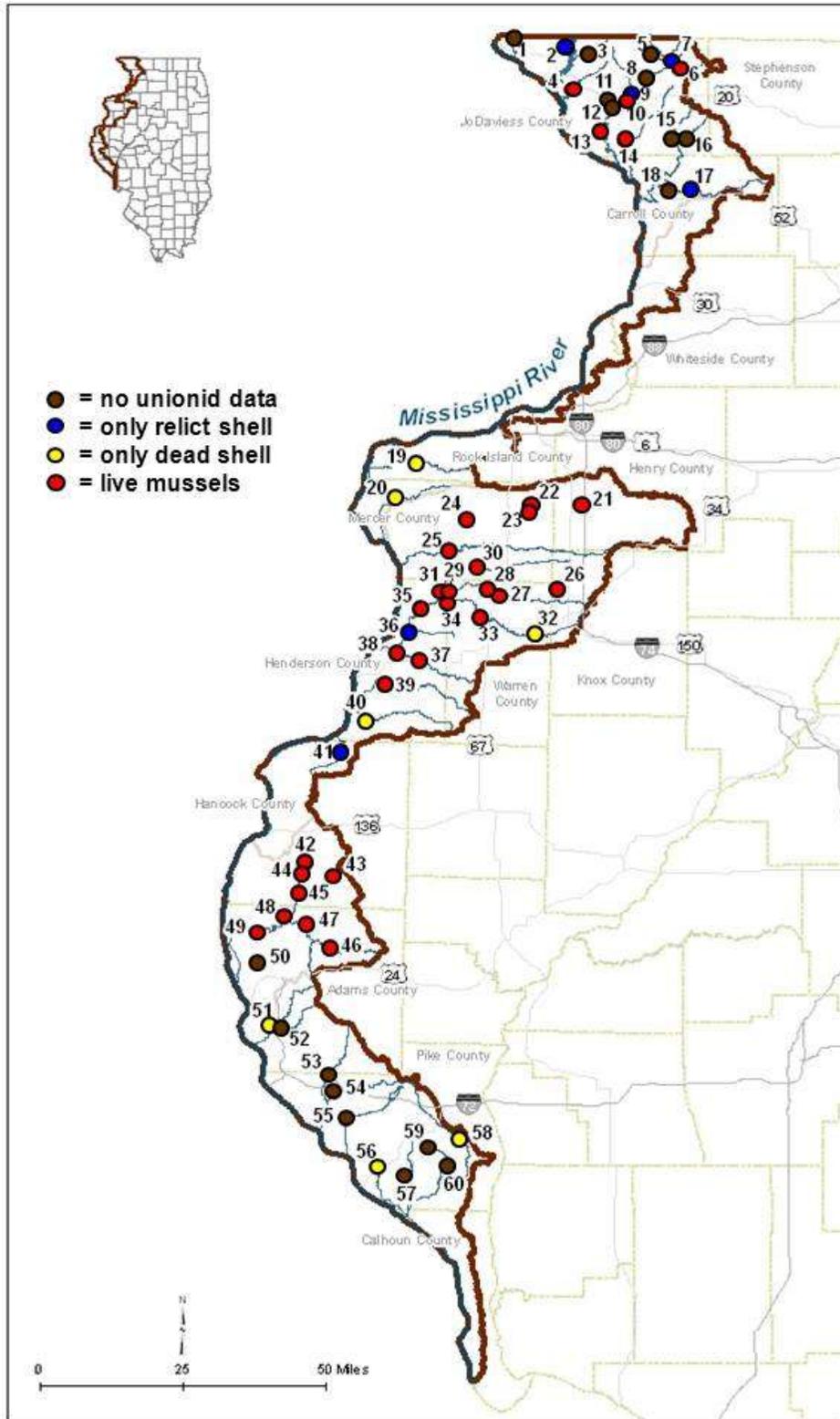


Figure 3. Sites sampled with no unionids (brown dots), relict shell only (blue dots), dead shell only (yellow dots), and live mussels (red dots).

Figure 4a. North Mississippi Tributaries

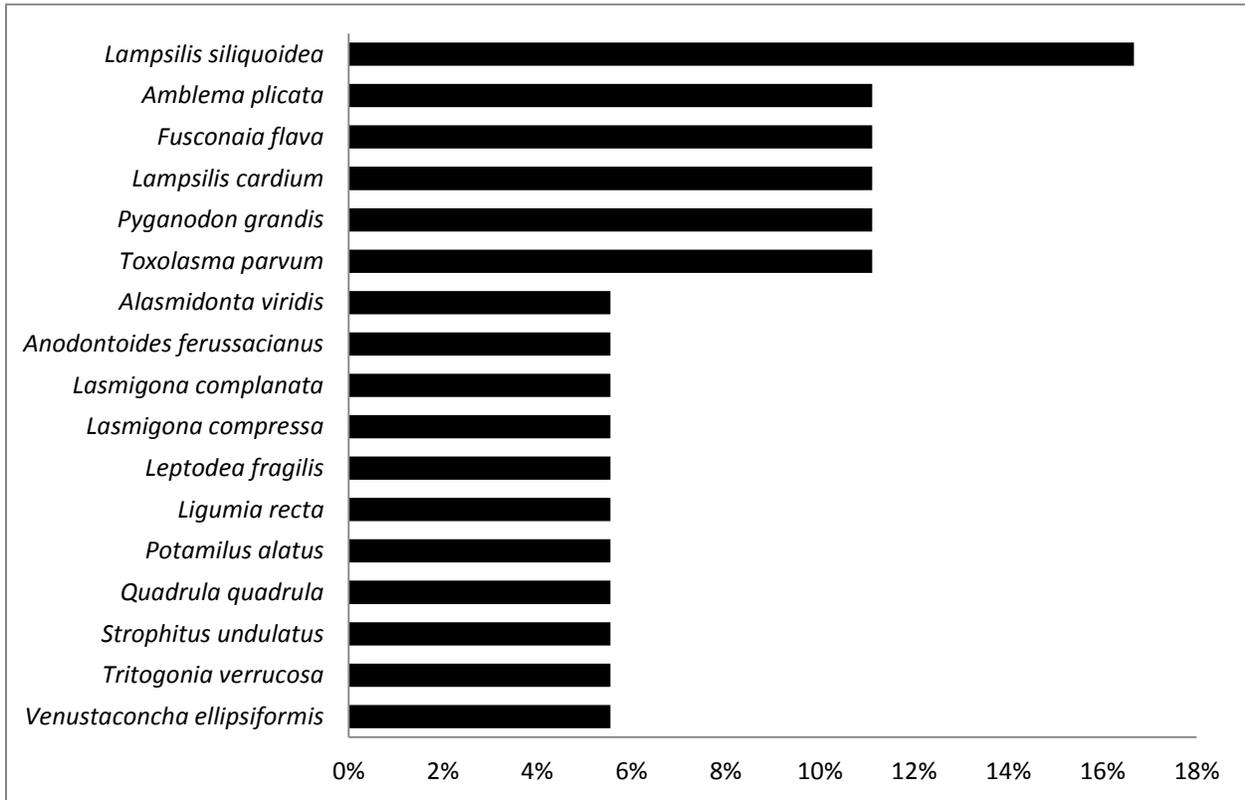


Figure 4b. North Central Mississippi Tributaries

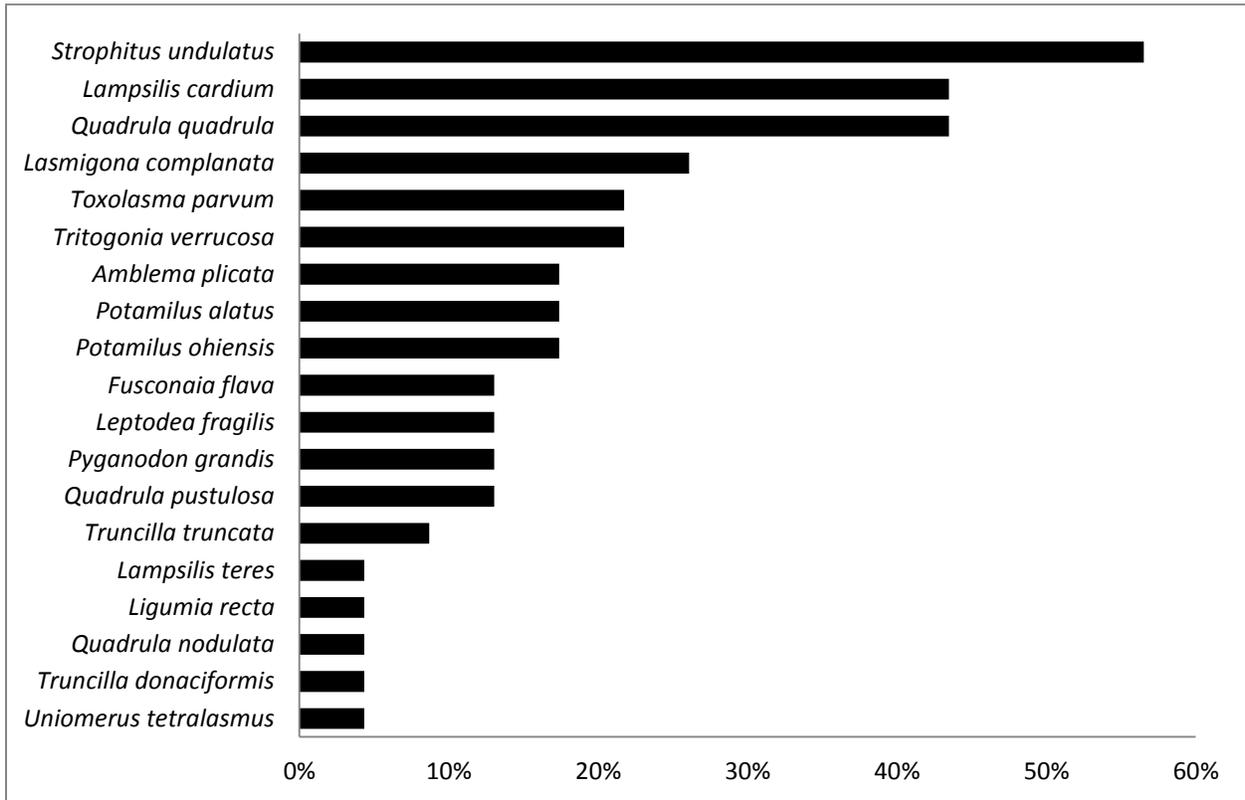


Figure 4c. Central Mississippi Tributaries

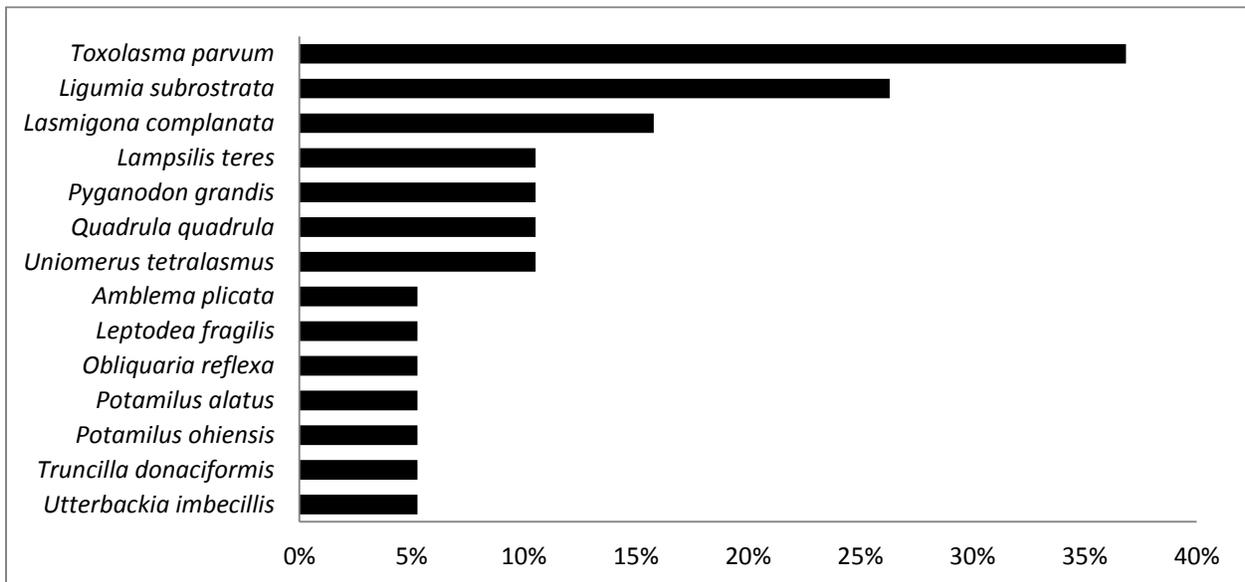


Figure 4. Number of sites where a species was collected live compared to the total number of sites sampled in the North Mississippi Tributaries (a. 18 sites), North Central Mississippi Tributaries (b. 23 sites) and Central Mississippi Tributaries (c. 18 sites).

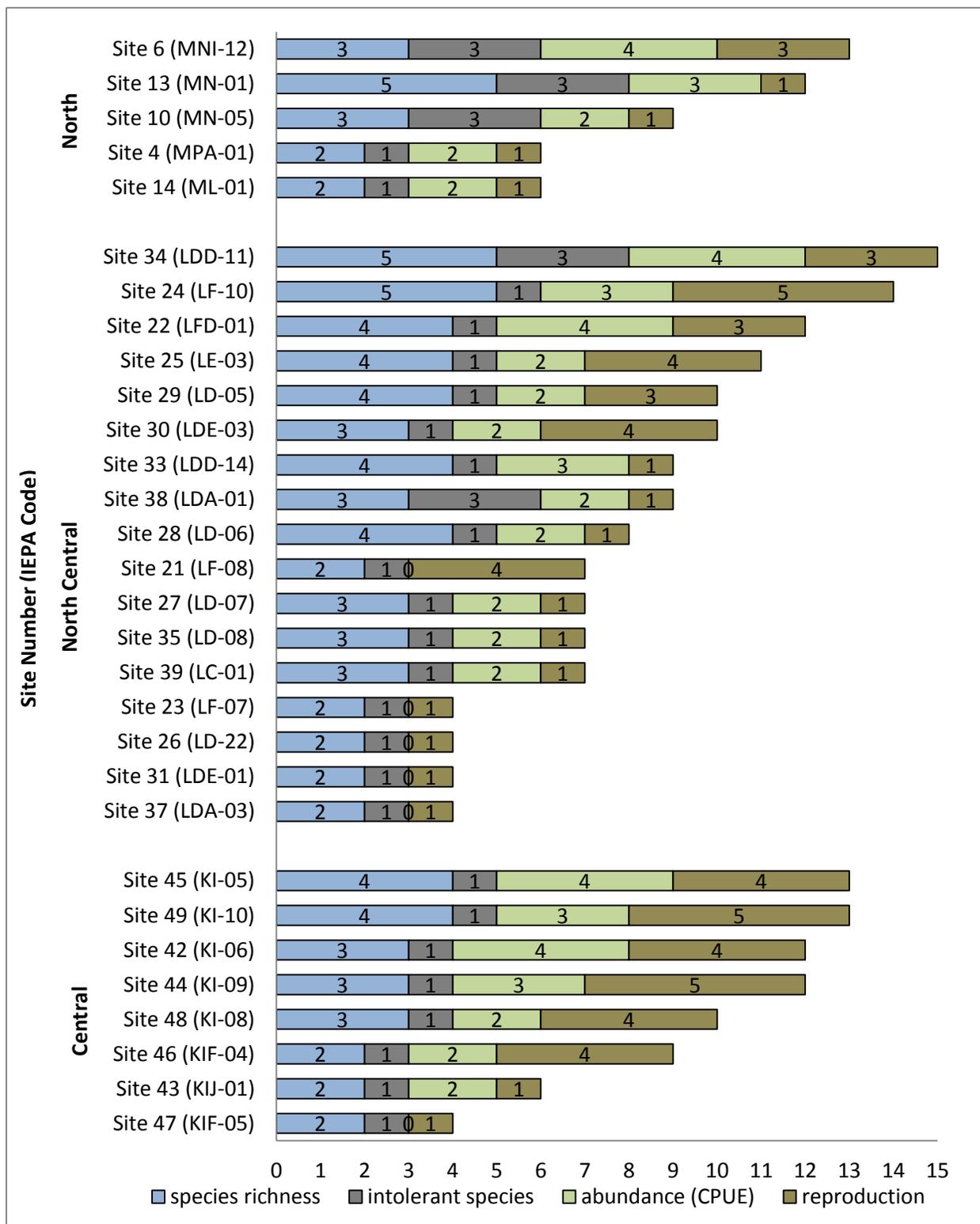


Figure 5. Comparison of Mussel Community Index (MCI) and MCI component scores for Mississippi River tributary sites based factor values from Table 3.

Appendix 1. Scientific and common names of species. Status (in 2012): SGNC-Illinois' species in greatest need of conservation, ST-state threatened, SE-state endangered, FE-federally endangered, X-extirpated in Illinois.

Scientific name	Common name	Status
Subfamily Anodontinae		
<i>Alasmidonta marginata</i>	elktoe	
<i>Alasmidonta viridis</i>	slippershell mussel	ST
<i>Anodonta suborbiculata</i>	flat floater	
<i>Anodontoides ferussacianus</i>	cylindrical papershell	
<i>Arcidens confragosus</i>	rock pocketbook	SGNC
<i>Lasmigona complanata</i>	white heelsplitter	
<i>Lasmigona compressa</i>	creek heelsplitter	SGNC
<i>Lasmigona costata</i>	flutedshell	SGNC
<i>Pyganodon grandis</i>	giant floater	
<i>Strophitus undulatus</i>	creeper	
<i>Utterbackia imbecillis</i>	paper pondshell	
Subfamily Ambleminae		
<i>Amblema plicata</i>	threeridge	
<i>Cyclonaias tuberculata</i>	purple wartyback	ST
<i>Elliptio dilatata</i>	spike	ST
<i>Fusconaia ebena</i>	ebonyshell	ST
<i>Fusconaia flava</i>	Wabash pigtoe	
<i>Megalonaias nervosa</i>	washboard	
<i>Pleurobema rubrum</i>	pyramid pigtoe	X
<i>Pleurobema sintoxia</i>	round pigtoe	
<i>Quadrula pustulosa</i>	pimpleback	
<i>Quadrula quadrula</i>	mapleleaf	
<i>Tritogonia verrucosa</i>	pistolgrip	
<i>Uniomerus tetralasmus</i>	pondhorn	
Subfamily Lampsilinae		
<i>Actinonaias ligamentina</i>	mucket	
<i>Lampsilis cardium</i>	plain pocketbook	
<i>Lampsilis siliquoidea</i>	fatmucket	
<i>Lampsilis teres</i>	yellow sandshell	
<i>Leptodea fragilis</i>	fragile papershell	
<i>Ligumia recta</i>	black sandshell	ST
<i>Ligumia subrostrata</i>	pondmussel	
<i>Obliquaria reflexa</i>	threehorn wartyback	
<i>Obovaria olivaria</i>	hickorynut	
<i>Potamilus alatus</i>	pink heelsplitter	
<i>Potamilus ohioensis</i>	pink papershell	
<i>Toxolasma parvum</i>	lilliput	
<i>Truncilla donaciformis</i>	fawnsfoot	
<i>Truncilla truncata</i>	deertoe	
<i>Venustaconcha ellipsiformis</i>	ellipse	SGNC